# XAFS Studies of the Formation of Cobalt Disilicide on (√3×√3) 6H-SiC(0001)

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**Introduction**: Because of its unique properties, including high thermal conductivity and high saturated electron drift, silicon carbide (SiC) presents itself readily for use as a semiconductor in high-power/high-frequency devices. Cobalt disilicide ($CoSi_2$) is considered a promising electrical contact material to SiC due to its low resistivity and good thermal stability.

**Methods and Materials**: We studied in detail thin Co films grown directly, sequentially, and by co-depostion with Si on the (√3×√3)-R30° surface of 6H-SiC(0001). The structure, chemistry and morphology of the films were determined using x-ray absorption fine structure (XAFS), x-ray photoelectron spectroscopy (XPS), Auger electron spectroscopy (AES) and atomic force microscopy (AFM).

**Results**: The local structure of the films was studied with XAFS. The Fourier transform of the XAFS data for directly, sequentially and co-deposited films as well as standard spectra for Co metal, CoSi and $CoSi_2$ are shown in Fig. 1. These spectra indicate mainly Co-Co bonds for the directly deposited Co film annealed at 700ºC. From a fit of the x-ray near edge (XANES) spectra, we estimate that the film consists of 70% Co metal and 30% $CoSi_2$. XPS and AES revealed a significant increase of the C peak suggesting that graphitic carbon is forming at the surface of the directly deposited and annealed film. Several films were grown sequentially and by co-deposition of Si and Co with a thickness ratio of 3.64:1 onto (√3×√3) 6H-SiC(0001). These films form $CoSi_2$ during annealing at 550ºC as is unambiguously shown by the XAFS data depicted in Fig. 1. The fact that the bilayers and co-deposited films show the same features in the Fourier transform as the $CoSi_2$ reference sample rules out the possibility that the films contain significant amounts of CoSi or Co metal (<5%). AES and XPS show that no graphitic carbon is forming at the film surface. AFM results show that annealing at 650ºC leads to islanding of the sequentially and co-deposited films leaving large areas of the underlying (√3×√3) SiC substrate uncovered. The smalles RMS roughness (2 nm) was found for the sequentially deposited films annealed at 550ºC.

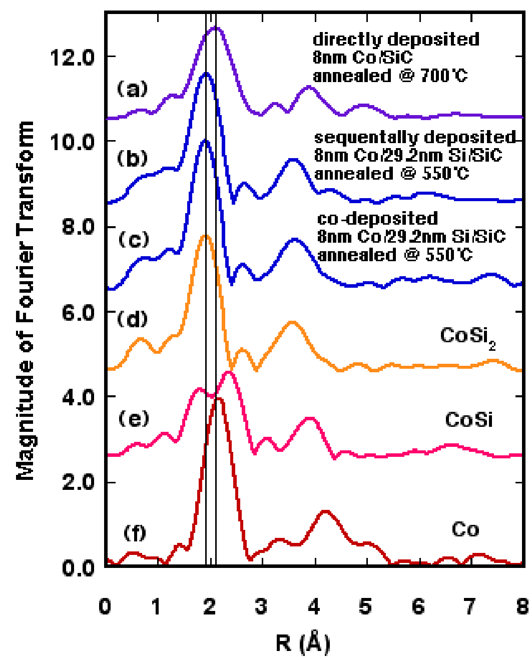


**Figure 1**. Fourier transform of $k^2$-weighted XAFS data for (a) 8nm Co/(√3×√3) SiC annealed at 700ºC, (b) 8nm Co/29.2nm Si sequentially, (c) co-deposited on √3×√3) SiC and annealed at 550ºC, (d) $CoSi_2$, (e) CoSi and (f) Co foil.

**Conclusions**: In our experimental study, we have found that directly deposited Co films on (√3×√3) 6H-SiC(0001) do not transform entirely to $CoSi_2$ during annealing and C segregation occurs on the surface of the films. On the other hand, sequentially and co-deposited films do form $CoSi_2$ after annealing at 550ºC, but also show islanding after annealing at 650ºC.

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**References**: W. Platow, D.K. Wood, K.M. Tracy, J.E. Burnette, R.J. Nemanich, D.E. Sayers, “Formation of cobalt disilicide films on (√3×√3) 6H-SiC(0001),” Phys. Rev. B (2000), accepted for publication.